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NAVAL SURFACE WARFARE CENTER

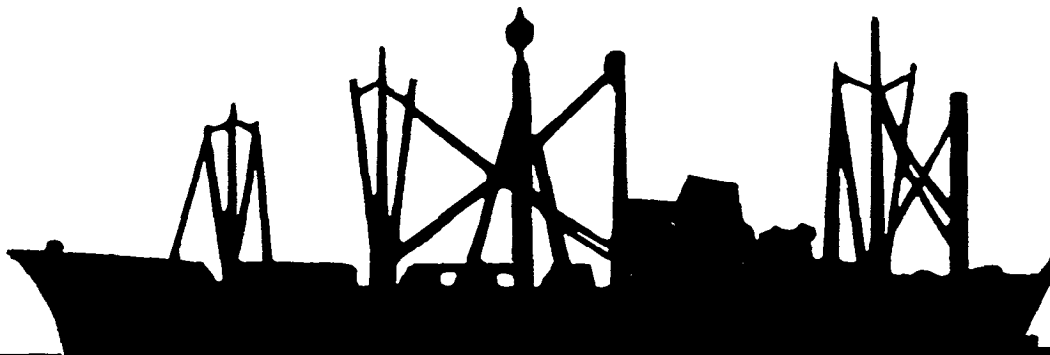
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I R E A P S

**PARTGEN: AN ADVANCED INTERACTIVE METHOD
FOR HIGHLY AUTOMATED PARTS GENERATION BASED ON THE DESIGN MODEL DATA**

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Oslo, Norway**

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ABSTRACT

This is a brief introduction to the present status of the AUTOMDDL development effort (AUTOKON) and an indepth description of the first module of an AUTOMDDL named PARTGEN. PARTGEN works on a topological model of the ship and is stored in the database. PARTGEN uses extensively interactive graphics and will virtually eliminate 90 percent of what today is called partcoding in the production phase. In addition to performing part generation, PARTGEN also has other valuable functions. It can do fairing of lines, interactively, to establish a preliminary hull form for building up the design model in the database. It has a report generator whereby the user can make extensive reports from the database and make user formulated layouts on the reports. PARTGEN also includes extensive automatic updating procedures due to changes. This is a benefit of having parts for production stored as topological data instead of as geometry.

PARTGEN

The first module in AUTOMODL

Introduction

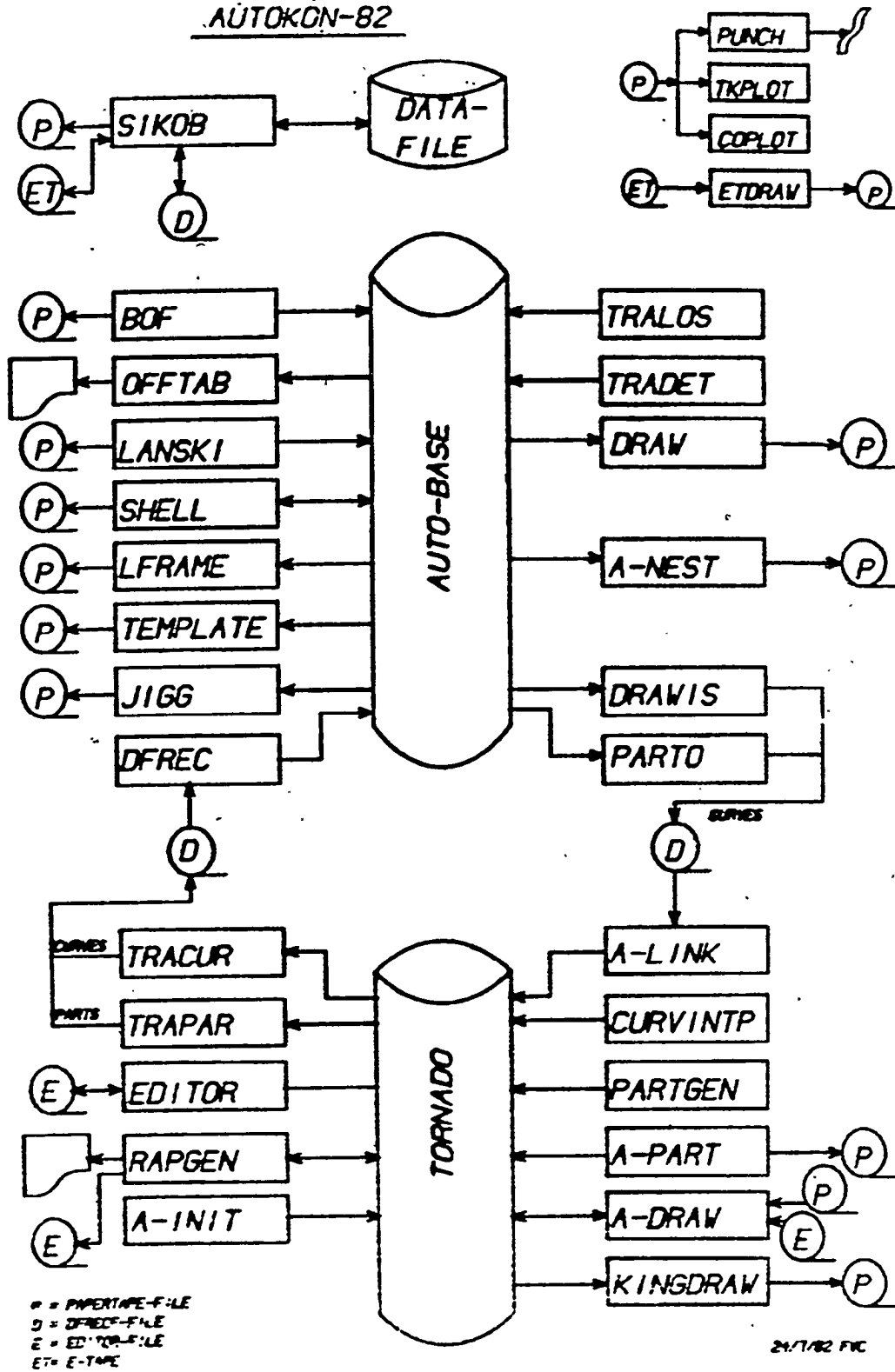
PARTGEN is the first available module in AUTOMODL. It is using the new Database system TORNADO which will be the common database for AUTOMODL. PARTGEN is an interactive tool to define steel structures in plane surfaces. The PARTGEN module can be used in three different ways.

- 0 PARTGEN can receive curves from other programs. These curves will then form various surfaces, and these surfaces will be in various stages of completion depending on the detailing-level done with other programs. These curves may include boundary curves for the surfaces (edges), intersection curves, trace curves (stiffener traces), seam curves and curves with cutouts.
- 0 PARTGEN can also build up the structure within a surface using available commands and macros.
- 0 PARTGEN can also be used as a combination of the two above. This will typically be the case when the structure is only partially finished before PARTGEN is used.

The regular output from PARTGEN is production parts ready for nesting. However, output or information is also stored in the database, and various reports can be generated as regular output.

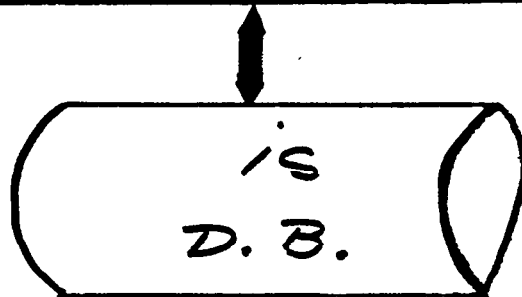
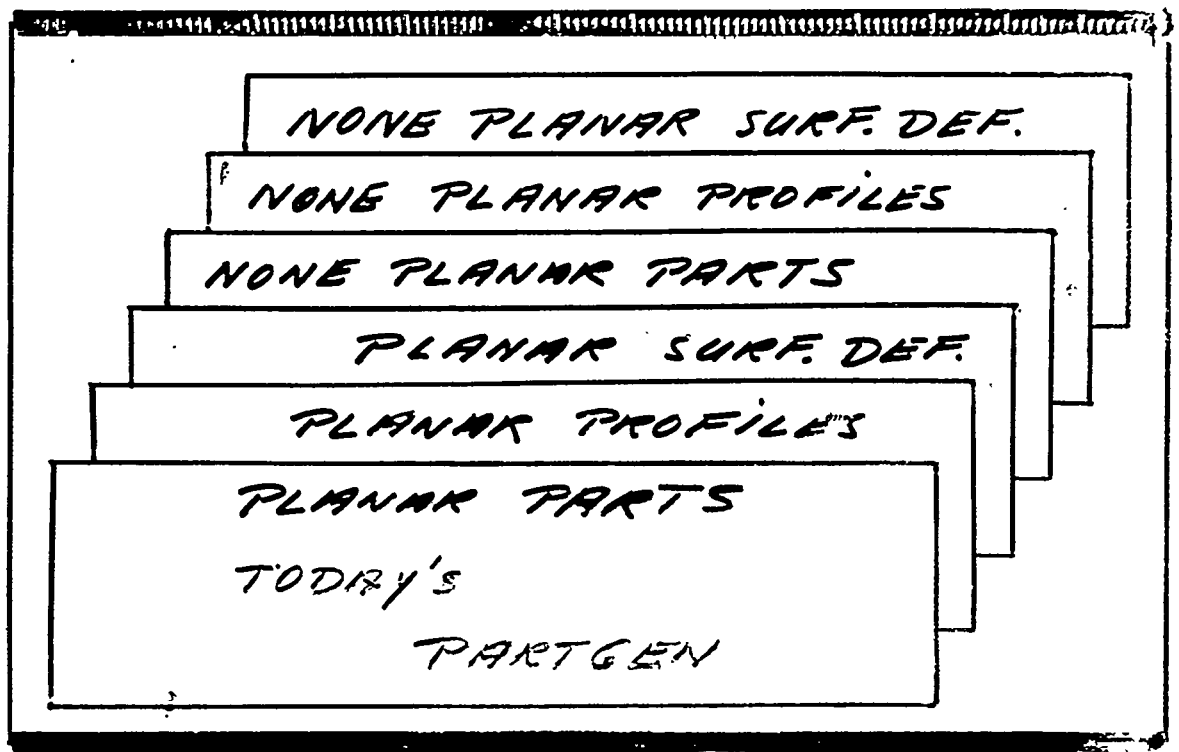
Output from PARTGEN can also be used by AUTODRAW for generation of drawings.

AUTOKON-82



PARTGEN IN AUTONODL

AUTONODL



System philosophy

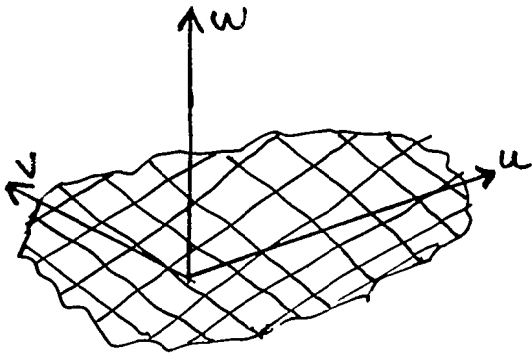
In PARTGEN there are several basic concepts that need some explanation.

- 0 Product. A product in PARTGEN is the entire structure the user wants to work with. It can be an entire ship, a half ship or a group of units. A product is normally given a name like YN 228AB. A project identification (Project number) is also linked to the product.
- 0 Surface. A product is built up of various surfaces. A surface is defined as a U, V, W-coordinate system, related to the global X, Y, Z system.
The surfaces in PARTGEN are given names by the user. The naming-conventions made so far should be familiar. PARTGEN is using names like: SHELL, DECK, PLTF, STRINGER, GIRDER, TFRAME etc.
- 0 Curves. A surface is built up by various curves, and a particular curve is always within a surface. These curves may be generated by PARTGEN itself, or they may be coming from other programs like BOF, TRALOS, TRADET etc.
There are several types of curves, and each curve has a name (type) and a numeric identification number.
The type of a curve also indicates what kind of curve it is. We have HOLE-CURVE (holes), SEAM-CURVES (seams, butts), TRACE-CURVES (traces of stiffeners), INTERSECTION-CURVES (curves formed by two surfaces intersecting each other) etc.

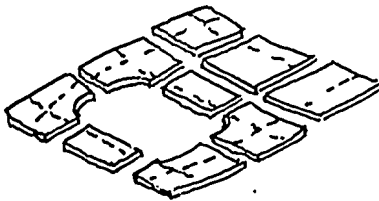
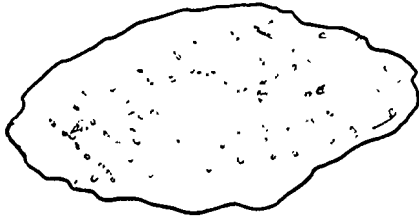
The three above mentioned concepts form the basis for part-generation with PARTGEN. Except for the Product, the user is free to manipulate surfaces and curves at any time in the PARTGEN process, thus being able to take care of last minute changes.

CONCEPTS AND RELATIONS

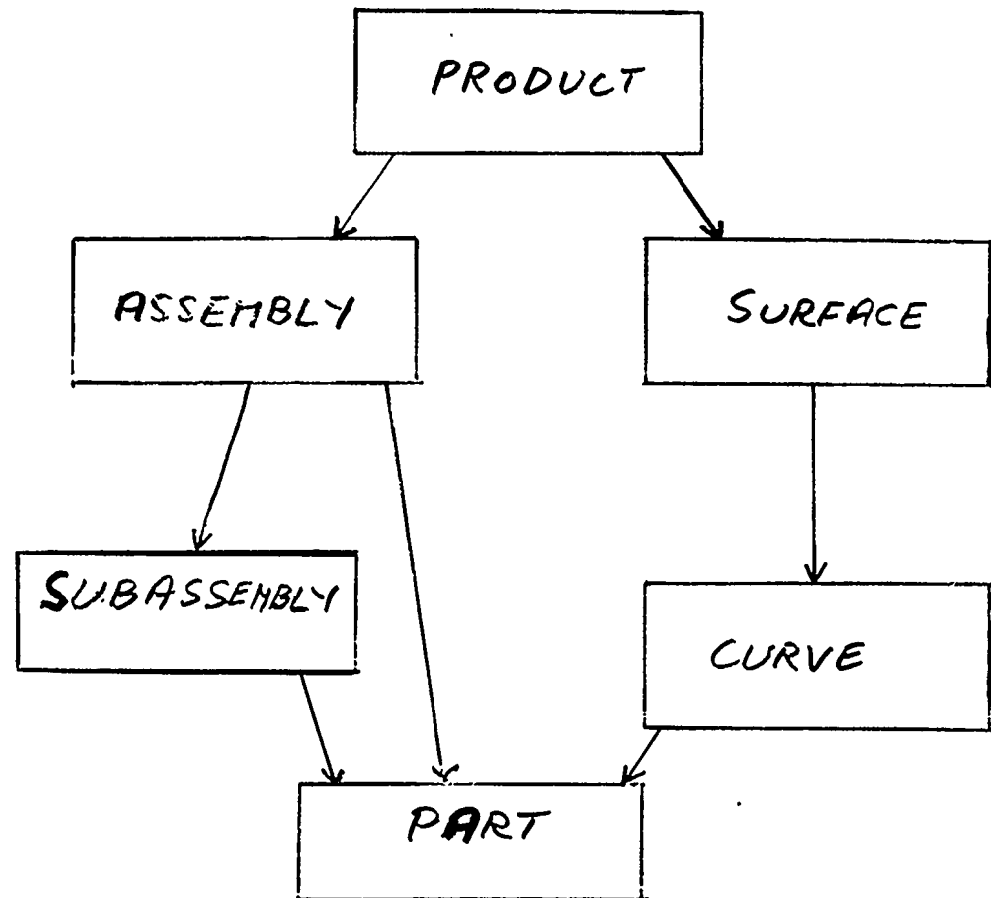
SURFACE (PLANE SURF.)



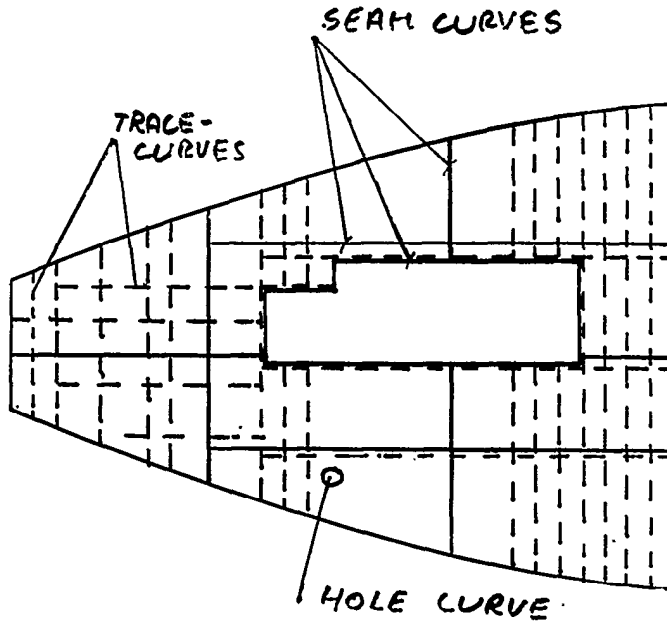
CURVES IN A SURFACE



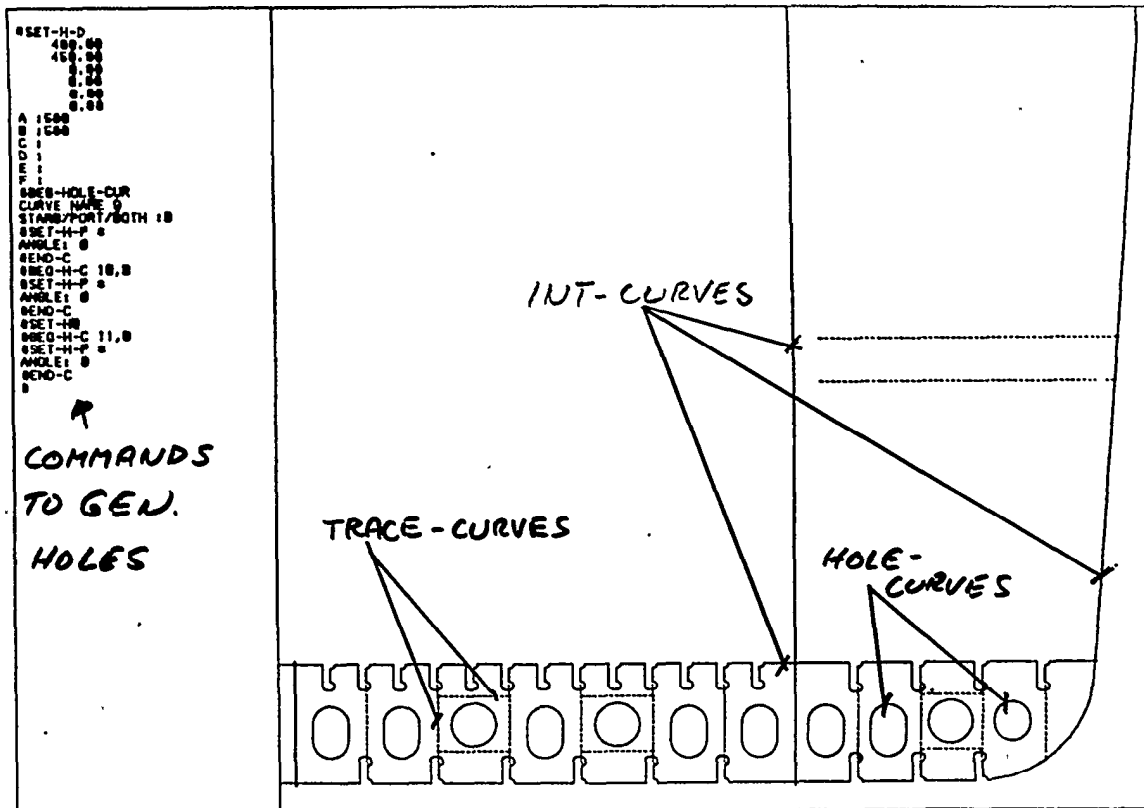
PARTS



CURVES IN A SURFACE



ALL CURVES COMMING FROM TRALOS/TRADET/ISDRAW
ALL CURVES CAN BE MODIFIED OR DELETED BY PARGEN
NEW CURVES OF ANY TYPE CAN BE ADDED BY PARGEN



- 0 Assembly. The assembly concept is used when PARTGEN is used for generation of production parts. The user can establish a tree structure with assemblies and subassemblies, where the assembly normally will be a block or unit. The assemblies have identification numbers as also the subassemblies have. An assembly or subassembly is built up by parts for production. A part can not be defined without belonging to an assembly.
- 0 Parts. Parts are defined in PARTGEN as belonging to an assembly or subassembly. One particular part will reside in a surface and contain various curves, also belonging to a surface.

PARTGEN is not a part splitting programs. It does not even have any part splitting capability. PARTGEN is using intersection points between curves to generate a part. The part is built up by topological points formed by the intersection points between the curves. This concept makes automatic updating of parts based on modifications to curves easy.

How PARTGEN works

Normally, the PARTGEN process will start up after, or at the end of building up the model of the structure in the database. The building up of the model in the database is today done by the programs BOF, LANSKI, TRALOS and TRADED. These are traditional batch oriented programs. However, they are not run as batch programs today. All the traditional waiting time in a batch environment has been eliminated by running the programs on-line on a minicomputer from a graphic screen (terminal) like Tektronix or LSI-ADM 32. Quick verification and response to changes are key words in this context. In the near future, the complete model build up in the database will be done by other AUTOMODL modules. Today, parts of the model can also be built up by PARTGEN.

The initial bulk of data belonging to the model is transferred to the PARTGEN database by the programs DRAWIS and AUTOLINK.

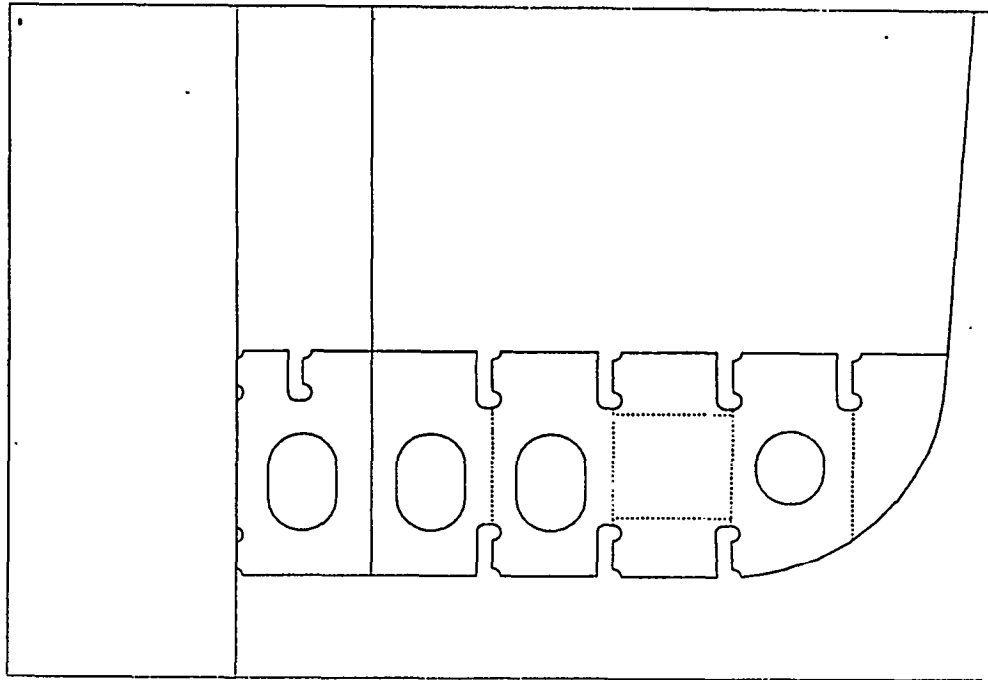
From the PARTGEN database the user will bring up a particular surface or group of surfaces on the screen.

This can be the whole surface or only a window of it.

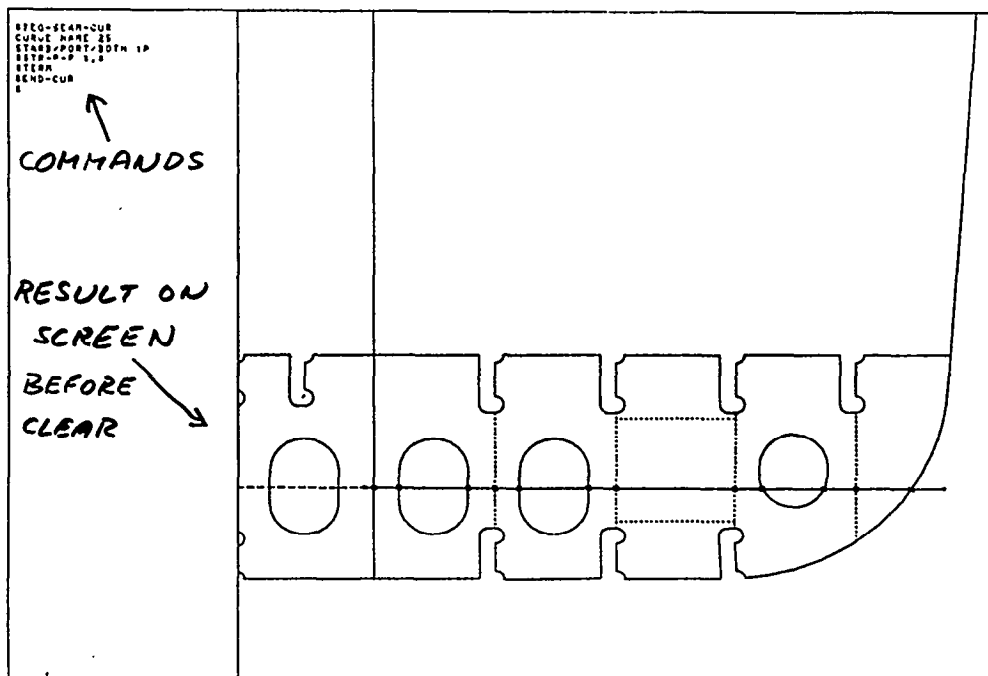
Normally a window is used for better clarity. If the surface is complete the partgeneration process starts immediately. However, if additional seams or holes have to be generated, this is now done with PARTGEN directly and included in the surface and stored in the database.

The actual partgeneration is done by using the crosshair to point at intersection points of curves that form the boundary of a particular part. However, before the actual partgeneration takes place, an assembly must be started by the command BEG-ASS name. Every curve that is inside the part will be included. This includes holes and traces of stiffeners. By the crosshair pointing, the topology of the part is generated.

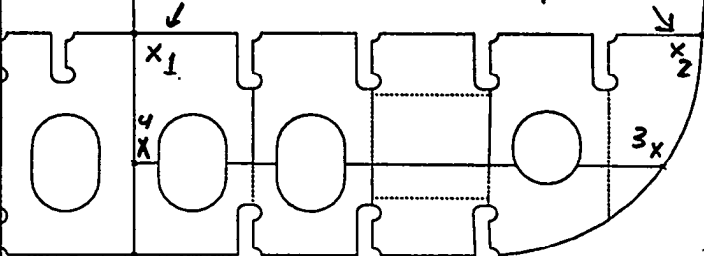
ZOOMING OF DETAIL FOR PART6EN



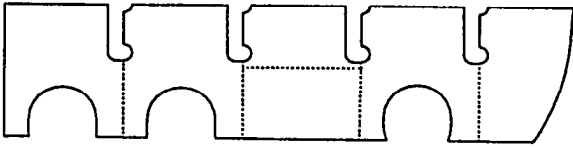
SEAM-CURVE GENERATION



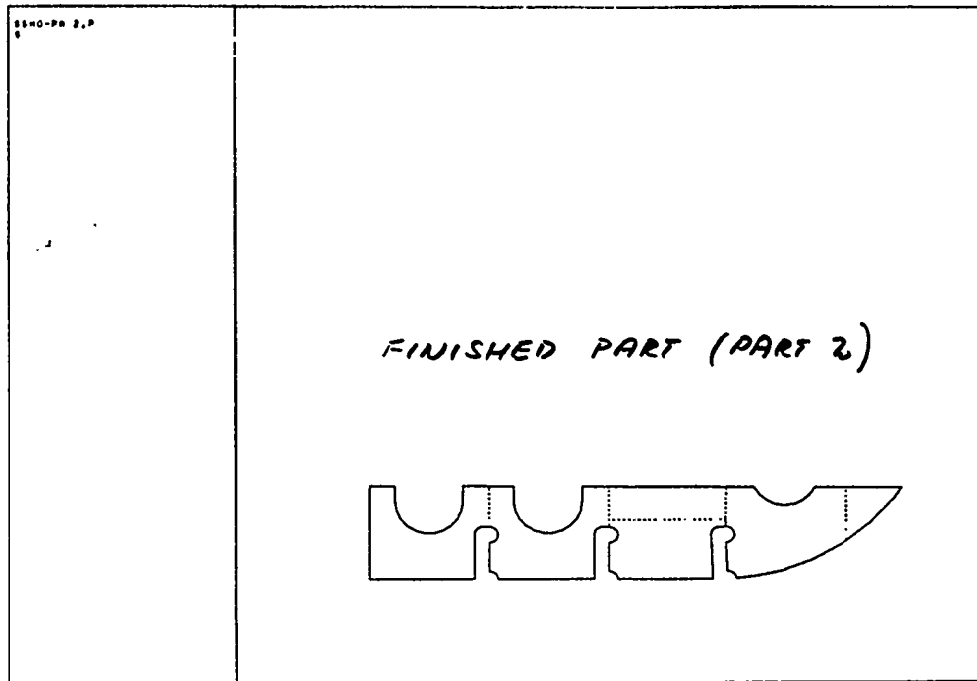
PART GENERATION

<pre> 026G-000 3 026G-PA PART NAME 1 STARS/PORT/BOHM-NONEIP 026G-PA-CE CORRECT PRINTY-N31V 026G-PA PART NAME 2 STARS/PORT/BOHM-NONEIP 026G-PA-CE </pre>	<p>COMMANDS TO GEN. TWO PARTS.</p> <p>RESULT ON SCREEN AFTER CLEAR.</p> <p>CROSSHAIR-POINTING SEQUENCE.</p> 
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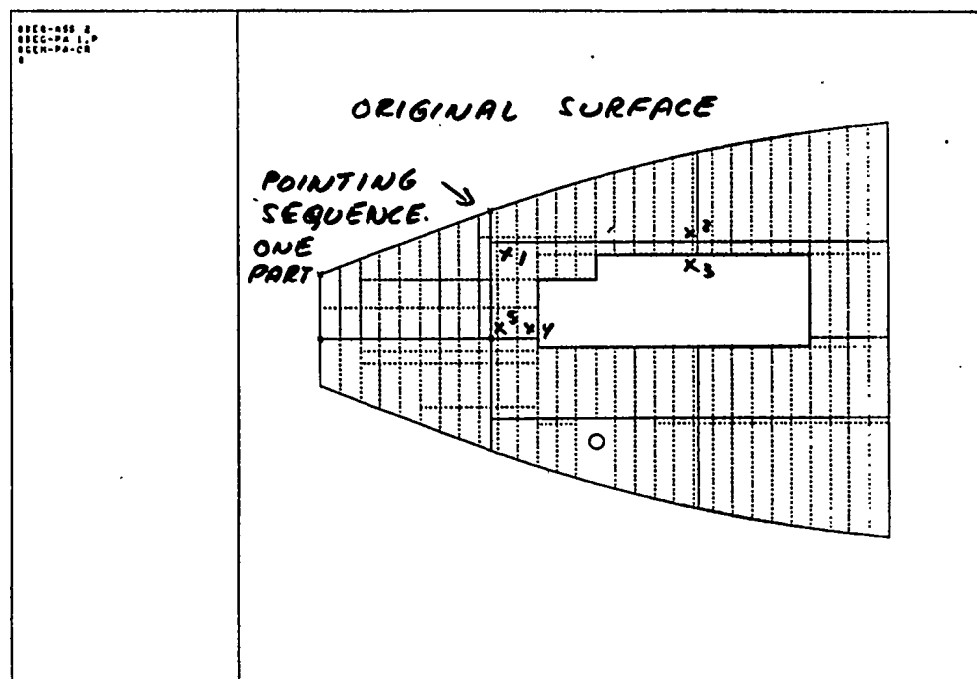
PART GENERATION

<pre> 026G-000 4 026G-PA 1,P </pre>	<p>FINISHED PART (PART 1)</p> 
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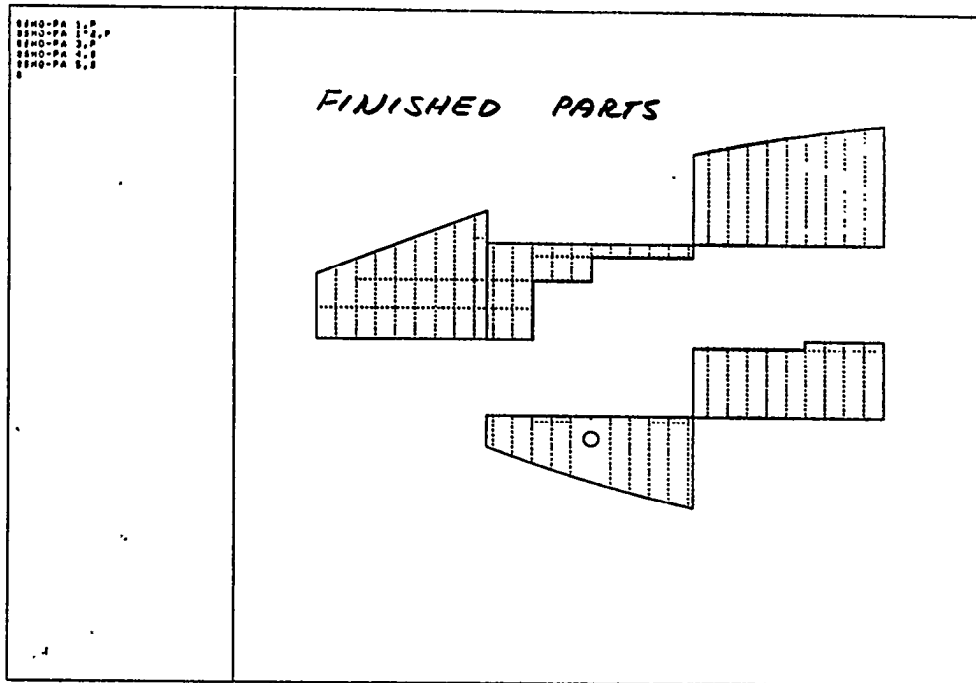
PART GENERATION



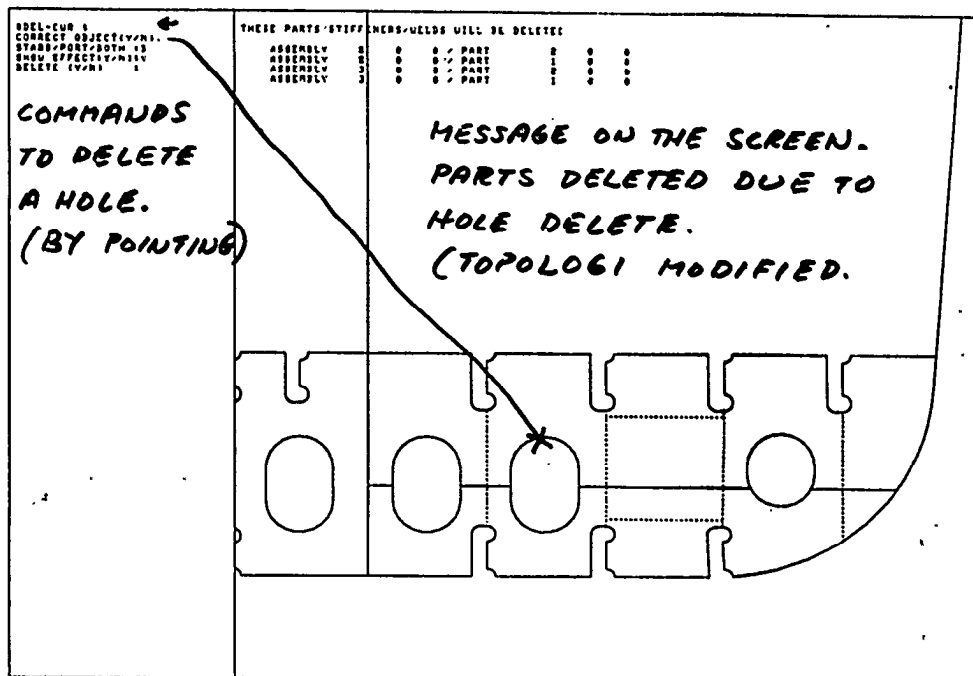
PART GENERATION



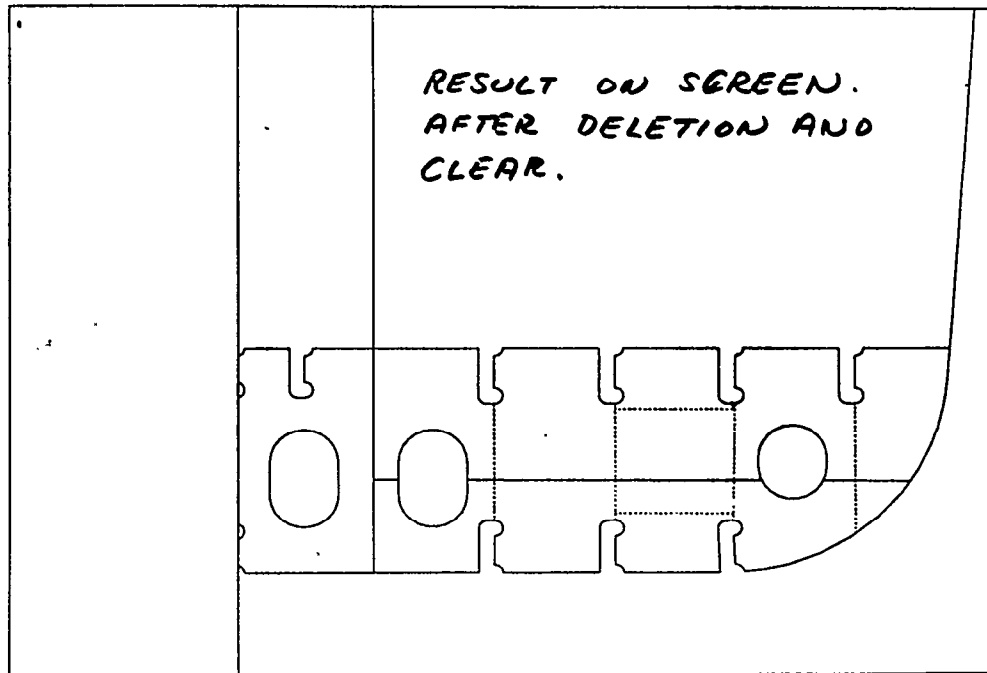
PART GENERATION



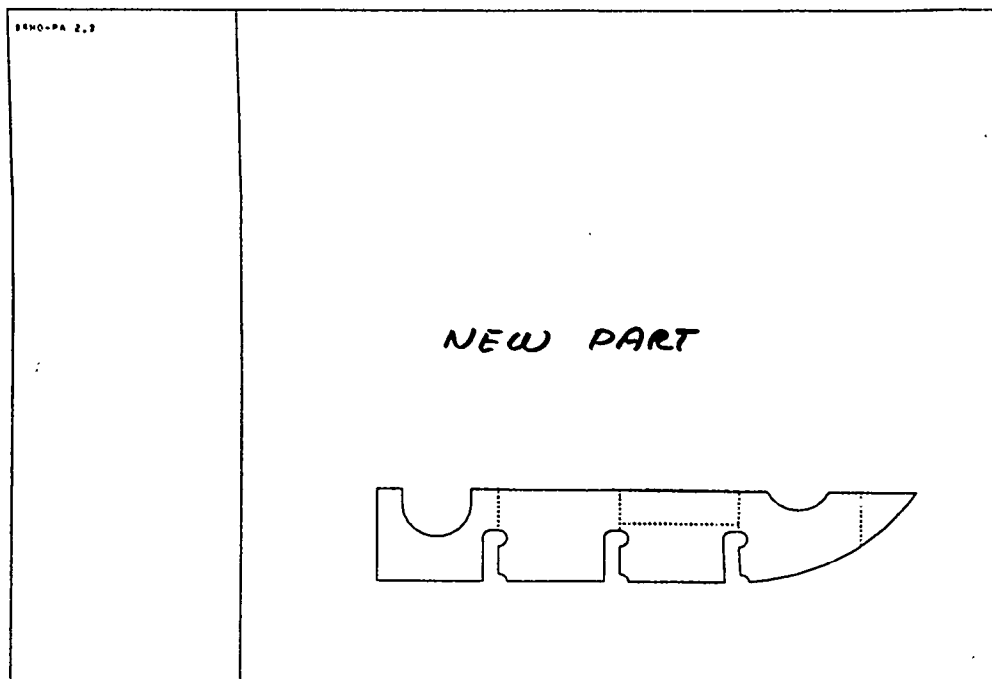
PART MODIFICATION



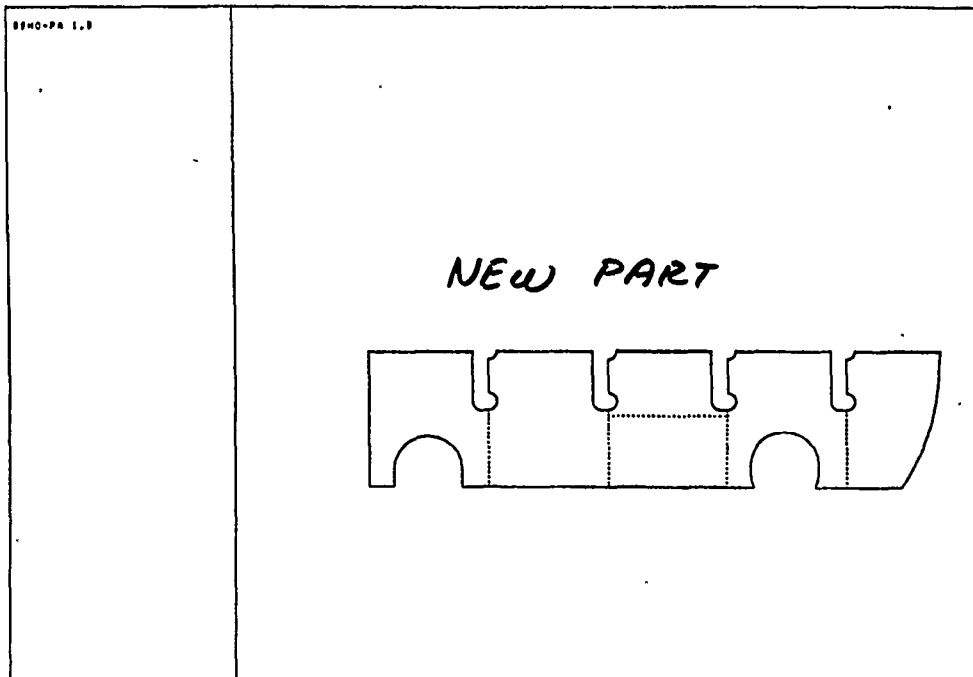
PART MODIFICATION



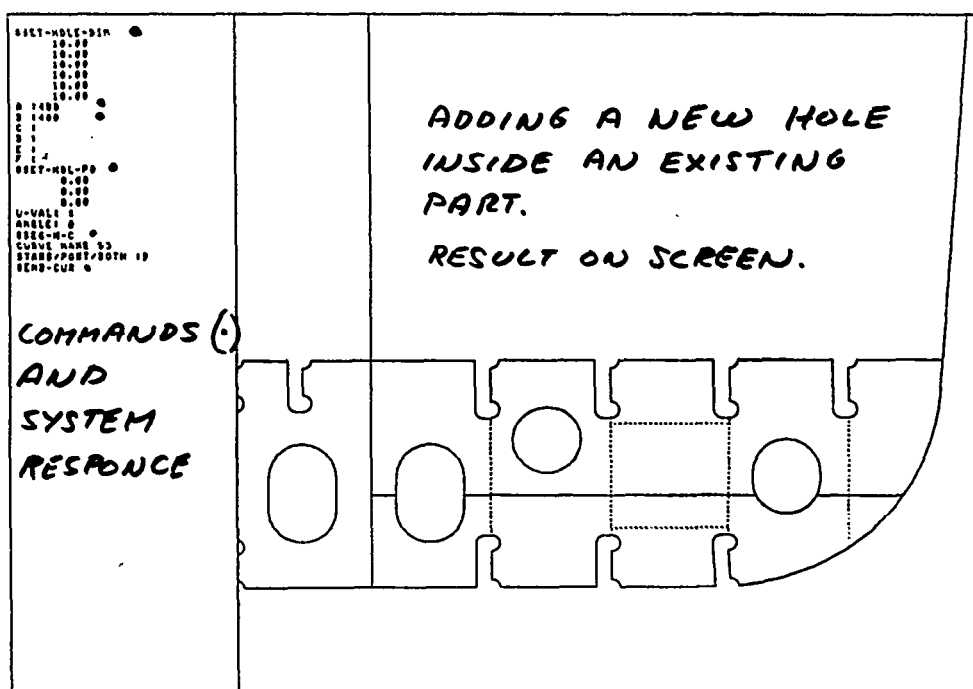
PART MODIFICATION



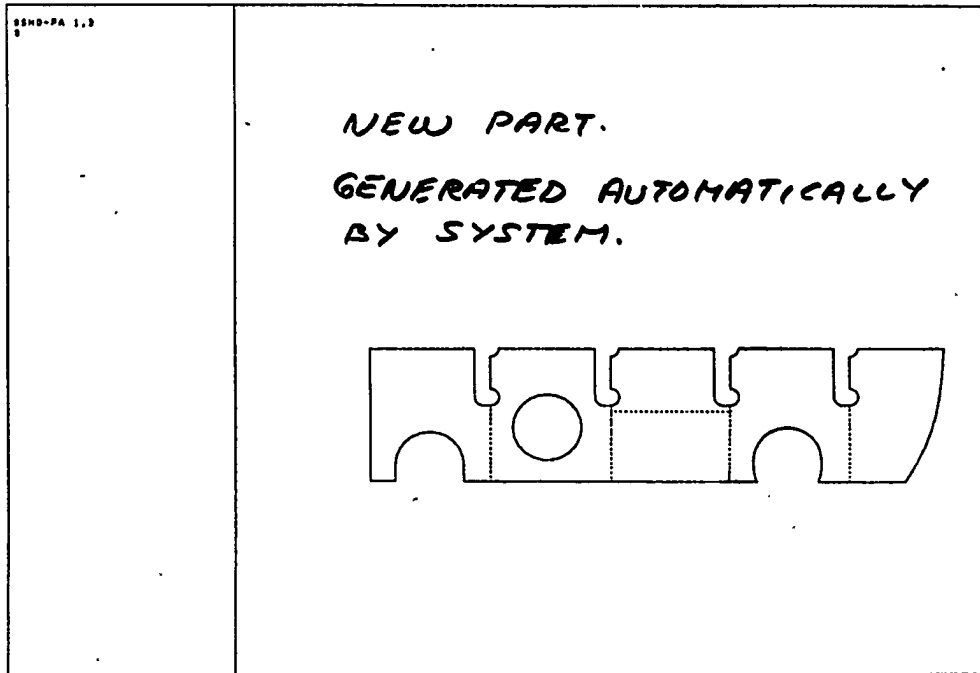
PART MODIFICATION



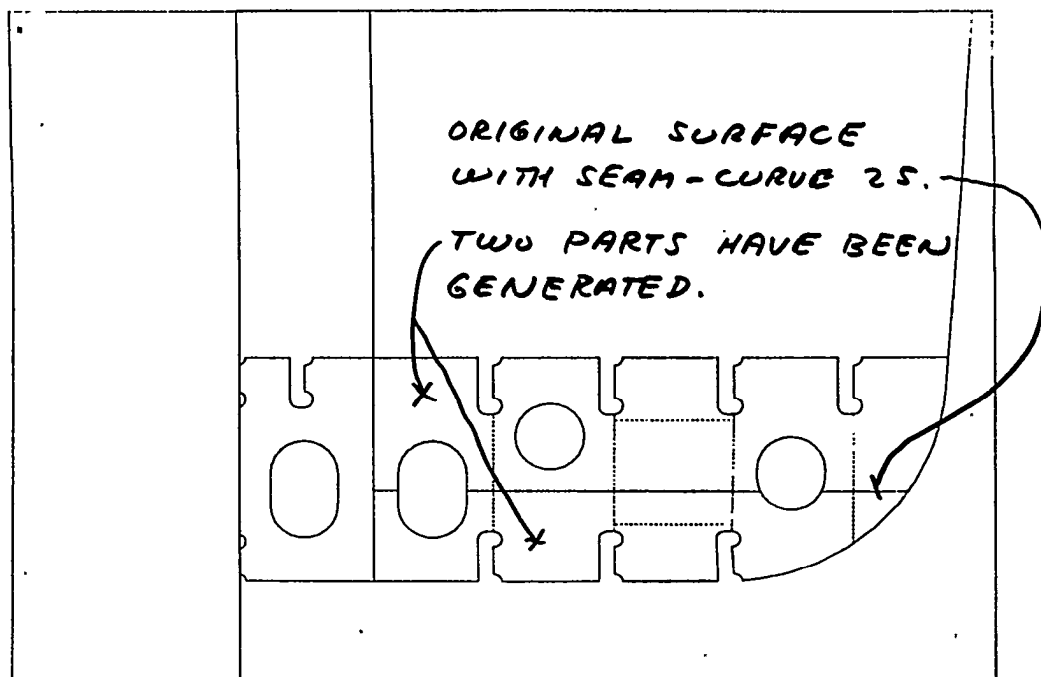
PART MODIFICATION



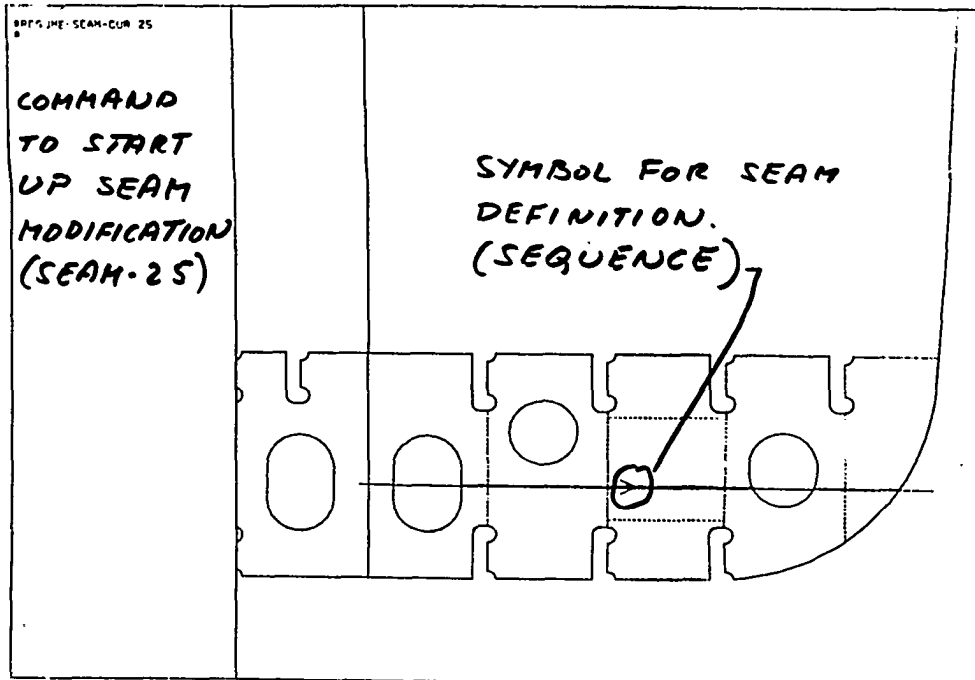
PART MODIFICATION



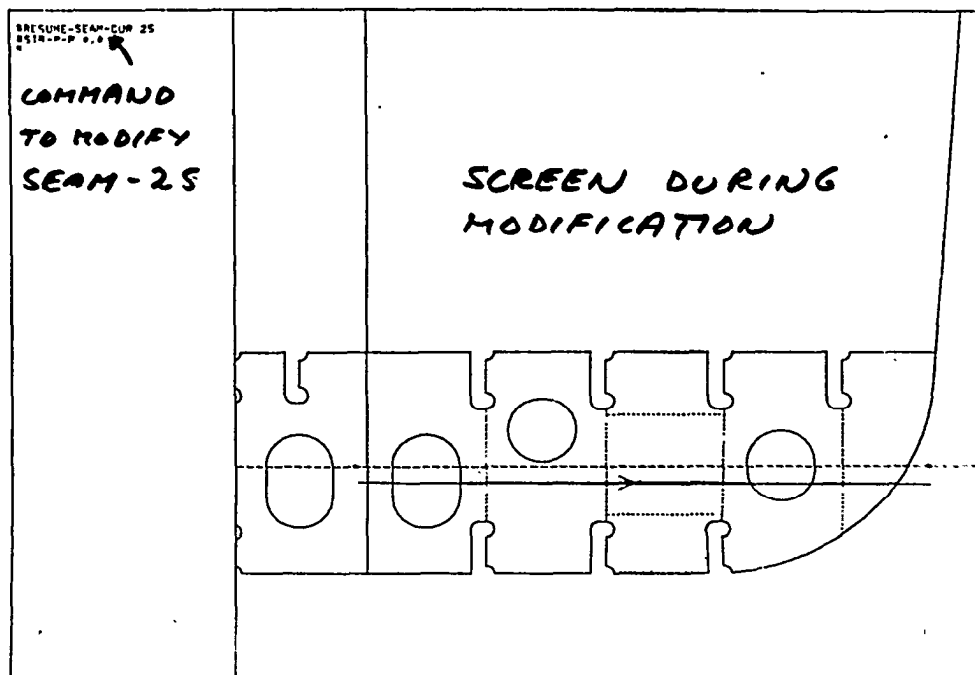
PART MODIFICATION



PART MODIFICATION



PART MODIFICATION

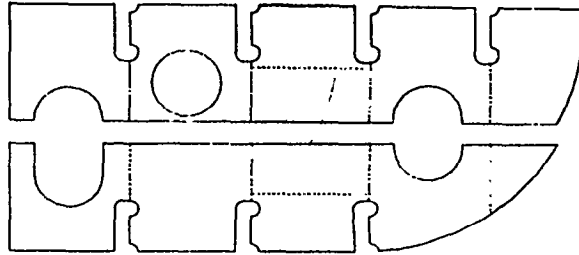


PART GENERATION

START/PORT/BOTH/NOHE:0
85HO-PA 2

88TOP
--DATABASE IS NOW COPIED.--
STOP BY USER
CP 1362 BLOCKS
LI 112 BLOCKS
PA 1824 BLOCKS
8888 STOP
OK.

THE TWO NEW PARTS
GENERATED AUTOMATICALLY
BY SYSTEM.



REPORT FROM PARTGEN

DO YOU WANT TO CONTINUE (OR SKIP) (Y/N/SK) I

ASSEMBLY - 01

MAI-15-1992

PARTS-NAME/NUMBER				THICKN. MM	AREA M2	WEIGHT KG	COS. X	GLOBAL COS. Y	COS. Z
PART	11	0	0	15.00	5.58	651.42	11958	-2877	2096
PART	12	0	0	15.00	10.29	1211.69	18977	-8204	2046
PART	18	0	0	15.00	12.48	1464.50	16818	-8763	2096
PART	14	0	0	15.00	5.55	651.42	11958	2877	2051
PART	15	0	0	15.00	10.29	1211.69	18977	8204	2051
PART	16	0	0	15.00	12.48	1464.50	16818	8763	2051
PART	30	1	0	9.50	12.61	940.83	14279	-1479	1051
PART	30	2	0	9.50	12.61	940.83	14279	1479	1051
PART	31	1	0	9.00	0.71	50.55	14518	8240	1226
PART	31	2	0	9.00	0.76	55.76	15142	5240	1175
PART	31	3	0	9.00	0.76	54.14	15766	8240	1145
PART	31	4	0	9.00	0.79	56.60	16390	8240	1112
PART	31	5	0	9.00	0.81	57.60	17014	8240	1095
PART	31	1	1	8.00	0.71	44.76	14518	-3249	1226
PART	31	2	1	8.00	0.76	47.78	15142	-8249	1175
PART	31	6	0	9.50	1.08	80.65	15765	-8249	1182
PART	31	7	0	9.50	1.11	82.32	16388	-8249	1187
PART	31	8	0	9.50	1.12	84.15	17012	-8249	1119
PART	32	1	0	9.50	0.76	57.50	15765	4420	1409
PART	32	2	0	9.50	0.84	62.36	16389	4420	1346
PART	32	8	0	9.50	0.91	67.85	17014	4420	1296
PART	18	1	0	9.50	4.12	307.28	11065	1940	1228
PART	19	1	0	9.50	1.16	86.50	11630	1070	991
PART	19	2	0	9.50	2.46	185.65	11630	2580	1816
PART	20	1	0	9.50	1.16	86.69	12515	1071	992
PART	20	2	0	9.50	2.38	218.98	12515	2677	1298
PART	21	1	0	9.50	1.16	87.16	12940	1080	985
PART	21	2	0	9.50	8.20	259.28	12940	2795	1290
PART	22	1	0	9.50	1.17	87.25	15565	1080	994
PART	22	2	0	9.50	8.54	264.16	15565	2928	1286
PART	23	1	0	9.50	1.16	86.87	14190	1072	990
PART	23	2	0	9.50	8.91	291.68	14190	8044	1267
PART	24	1	0	9.50	1.16	86.32	14815	1072	990
PART	24	2	0	9.50	4.20	313.45	14815	8176	1265
PART	25	1	0	9.50	1.16	86.87	15440	1072	990
PART	25	2	0	9.50	5.51	411.56	15440	-8112	1282
PART	25	4	0	9.50	4.67	348.79	15440	8808	1262
PART	26	1	0	9.50	1.16	86.92	16065	1072	990
PART	26	2	0	9.50	4.92	367.10	16065	8499	1249
PART	27	1	0	9.50	1.16	86.87	16690	1072	991
PART	27	2	0	9.50	5.84	398.60	16690	8535	1242
PART	28	1	0	9.50	1.04	77.57	17315	1204	1044
PART	28	2	0	9.50	6.50	484.99	17315	-8475	1212
PART	28	4	0	9.50	5.83	434.76	17315	3539	1246
TOTAL						14160.98	14718	620	1573

Any time, later, that the topology of the part is changed, the user will get a message on the screen that part nos. involved will be deleted.

If, on a finished part, the internal structure is changed, by adding a hole or removing a stiffener trace, the parts involved will be automatically updated without any interference by the user. If the user wants to generate snipes (corner cutouts) at one or more corners of the parts this is done by initially using a SET-command to establish a basic radius.

(SET-CORNER-OUT-RAD 10). Now **10** mm is set as basic radius for corner snipes. When pointing at a corner with the crosshair and using the 2 key on the keyboard when pointing, a corner cutout with radius 20 mm is generated at that corner.

By proceeding in this way parts are generated and stored in assemblies in the database. Weights and center of gravities can be generated for assemblies and printed out in various formats. Also other reports from the database can be generated by report-generator facilities.

The PARTGEN commands include all the AUTOPART commands familiar to the yards using this module presently. This means that all the geometry possibilities in AUTOPART are available in PARTGEN, and so are the macro facilities. This fact will make the transition from AUTOPART to PARTGEN easy and quick for old users.

By using the PARTGEN module for production part generation, the actual part coding, as we know it from ALKON and AUTOPART will in effect disappear, and thus represent a tremendous saving in time required to generate production parts. A conservative estimate of 30-50% savings in manhours at the loft for part generation can be expected.

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